Docket No.: 2585-0129PUS1
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Marco Mario TIVELLI et al.

Application No.: 10/554,075

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Art Unit: 1793

For: SEAMLESS STEEL TUBE WHICH IS INTENDED TO BE USED AS A GUIDE PIPE AND PRODUCTION METHOD THEREOF

Examiner: Mark L. Shevin

DECLARATION UNDER 37 CFR §1.132

MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Madam:

I, Alfonso Izquierdo, declare the following.

I am familiar with the present application, the outstanding Office Action, and the cited reference to JP 09-235617 issued to Kondo et al. (hereinafter "Kondo").

The present invention is manufactured by the following steps, first manufacturing of the steel with the addition of certain amounts of elements during the manufacturing and the elimination of other elements so as to produced the final composition in % by weight that contains besides iron and inevitable impurities the following C 0.06 to 0.13, Mn 1.0 to 1.30, Si 0.35 max, P 0.015 max, S 0.003 max, Mo 0.10 to 0.20, Cr 0.10 to 0.30, V 0.05 to 0.10, Nb 0.020 to 0.035, Ni 0.30 to 0.45, Al 0.015 to 0.040, Ti 0.020 max, N 0.010 max, Cu 0.20 max, also the chemical composition complies with the relationship among the alloying elements $0.5 \leq (Mo+Cr+V) < 1$, $(Mo+Cr+V)/5+(Ni+Cu)/15 \leq 0.14$, the second steps is the manufacturing of the solid cylindrical piece steps through the use of a multi stand pipe mill with retained mandrel that for pipe thickness equal or greater than 30 mm works at temperatures higher than 1000°C, the third step air cool of the solid cylindrical piece, the fourth step is the heat treatment of the

solid cylindrical piece consisting of austenitizing to a temperature of between 900°C and 930°C, followed by an interior-exterior hardening in water and then heat treatment for tempering at a temperature of between 630°C and 690°C as defined by the following equation: T_{temp} (°C) = [-273+1000/(1.17-0.20C-0.3Mo-0.4V]±5.

Assuming that my understanding of the reference JP 09-235617 issued to Kondo is correct, Kondo discloses a manufacturing process of direct quenching (i.e. quenching just after hot rolling, without decreasing the pipe temperature below Ar_3) and tempering process. In particular, their effort is to reduce and control the dispersion of mechanical properties. The key means proposed to solve the problem of high scatter of strength and toughness properties in the case of the direct quenching process are as follows: one is heating the whole steel pipe in front of direct quenching unit. This step allows to promote recrystallization and consequent grain refinement of the steel which is work hardened after hot rolling at temperatures of 800°C to 1050°C with a reduction ratio equal or higher than 40%, another proposal is the direct quenching at a cooling rate greater than a critical value as a function of the tube thickness.

Assuming that my understanding of the reference JP 09-235617 issued to Kondo is correct , as a result of the Kondo manufacture, the steel pipe of Kondo would have the following wide chemistry range in weight %, C 0.02 to 0.15, Si 0.1 – 1.15, Mn 0.5 – 0.20, sol Al 0.0001 – 0.5, Cr 0 to 1.5, Mo 0 to 1.5, Ni 0 – 2.5, Ti 0 to 0.08, Nb 0 – 0.08, V 0 to 0.3, Zr 0 to 0.08, Ca 0 to 0.01, Cu 0 to 0.8 and B 0 to 0.008. The remainder consists of Fe and inevitable impurities and among inevitable impurities P 0.05% or less. Assuming that my interpretation is correct the mechanical properties following the manufacturing process discuss by Kondo of heat just before direct quenching showed yield strength dispersion is small and homogeneous also about a hoop direction, also about the longitudinal direction. On the other hand, when applied conventional direct quenching has large dispersion, while a longitudinal direction and the hoop direction of the value of yield strength itself are low. It is not clear what they claim in terms of strength, for hardness does not include the values. Kondo also discuss that if direct quenching accompanied by heat treatment is not performed after rolling like his invention method to steel with such low hardenability, they show that a homogeneous steel pipe is not obtained with high intensity. The yield strength values described in the Kondo have a range from 47.8 kgf/mm^2 to 67.6 kgf/ mm^2

as per table 7 and the toughness transition temperature in base metal range from -57 °C to -87 °C as per table 8 and 9, the toughness transition temperature range in the HAZ range from -39 °C to -74°C as per table 8 and 9. The weld cracking sensitivity was measured by the Y-globe type weld cracking test tables 8 to 10. There is no claim made and there is lack of information in regards the following mechanical properties: yield strength at elevated temperature or a different one from the one reported which is assumed to be at room temperature, no guarantee or values related to hardness, no guarantee or values reported related to cracking resistance measured by the fracture mechanics (CTOD) test and corrosion resistance. There is no claim and there is lack of information of the type of microstructure promoted within this process.

By comparison the steel pipe of the present invention has a chemical composition expressed in % by weight of additional elements C 0.06 to 0.13, Mn 1.0 to 1.3, Si 0.35 max, P 0.015 max, S 0.003 max, Mo 0.10 to 0.20, Cr 0.10 to 0.30, V 0.05 to 0.10, Nb 0.020 to 0.035, Ni 0.30 to 0.45, Al 0.015 to 0.040, Ti 0.020 max, N 0.010 max and Cu 0.20 max. In order to guarantee a satisfactory hardenabiltiy of the heavy gauge equal or higher than 30 mm and good weldability, the aforementioned elements should satisfy the following relationships $0.5 \leq (Mo+Cr+V) < 1$, $(Mo+Cr+V)/5+(Ni+Cu)/15 \leq 0.14$. The combination of the chemical composition in special the addition of elements such as Mo, Ni and Cr and manufacturing process in special the development after tempering of a lower bainite microstructure, polygonal ferrite with small regions of martensite high in C with retained austenite dispersed in the matrix, the invention discovered that the increase in size in the dimension of the austenitic grain from 12 microns to 20 microns produces an increase in the resistance of the steel, but at the same time worsens the factor of transition temperature, so the austenitic grain size should not exceed the 20 microns, it was also defined a maximum fraction in percentage of polygonal ferrite preferably below 30%, the before mentioned microstructure developed a seamless steel tube having a gauge wall ≥ 30mm with mechanical, yield and tensile strength resistance from room temperature up to 130°C, good hardening, good toughness, good resistance to cracking in the metal base, the HAZ and good corrosion resistance. The main mechanical, fracture mechanics, weldability and corrosion characteristics guarantee by this invention are: mechanical (yield and ultimate tensile strength) from room temperature up to 130°C $YS_{Troom} \geq 65$ksi, $YS_{130^\circ C} \geq 65$ ksi, $UTS_{Troom} \geq$

77ksi, $UTS_{130°C} \geq 77$ ksi, YS/UTS ratio ≤ 0.89, Elongation $\geq 20\%$, toughness properties measured by the charpy test by the absorbed energy evaluated at a temperature of -20°C $\geq$ 380 Joules, Shear Area at -10°C = 100%, resistance to cracking measured by the CTOD test at a temperature from -10 °C up to -40°C $\geq$ 0.8 mm in the base metal and a CTOD $\geq$ 0.5 mm at a temperature of 0 °C in the heat affected zone, Hardness in based metal $\leq$220HV10, corrosion resistance measure by the Hydrogen Induced Cracking Test, HIC, in accordance with NACE TM0284 standard with solution A being 1.5% maximum for Crack Thickness Ratio (CTR) and 5.0% max for Crack Length Ratio (CLR), the corrosion resistance is achieved based on the combination of the type of microstructure and kept residual elements in weight % such as P below 0.015 and S below 0.003.

As per my understanding of the cited reference JP 09-235617, Kondo discuss strength properties at room temperature, toughness measured by reporting the transition temperature in pipe body and HAZ. Kondo reported the weld cracking sensitivity, also reported higher content of residual elements compared to the present invention such us P, all values in table 2 are equal or above 0.020. Kondo does not guarantee the yield and/ or ultimate tensile strength at elevated temperature, does not gurantee elongation values at room or elevated temperature, does not guarantee a YS/UTS ratio, does not guarantee hardness values which are directly related to the strength levels of the material and its weldability, does not gurantee the cracking resistance measured by CTOD which a recognized test method in order to assess the crack resistance of the pipe body and HAZ and does not guarantee the corrosion resistance.

All before mentioned characteristics do not gurantee by Kondo were developed by the present application and resulted from the combination of the chemical composition and the manufacturing process developing the mechanical, fracture mechanical, weldability and corrosion properties claimed in the present invention, the manufacturing process for seamless steel tube made up of the following steps: 1. manufacturing the steel, 2 obtaining the solid cylindrical piece, 3. perforating said piece, 4. laminating said steel piece, 5. Subjecting the laminated tubing to heat treatment process consisting of austenitizing to a temperature between 900°C and 930 °C followed by exterior-interior hardening in water and then heat treatment for

tempering at a temperature of between 630°C and 690 °C as defined by the equation T_{temp} (°C) = [-273+1000/(1.17-0.20C-0.3Mo-0.4V]±5.

The before mentioned manufacturing process differs from the one discuss by Kondo, which as per my understanding is based on direct quenching (i.e. quenching just after hot rolling, without decreasing the pipe temperature below Ar_3) and tempering process and where the key means proposed to solve the problem of high scatter of strength and toughness properties in the case of direct quenching process mentioned were heating the whole steel pipe in front of direct quenching unit, the other one direct quenching at a cooling rate greater than a critical value as a function of tube thickness.

Based on the above mentioned, is my opinion that Kondo does not make obvious the present inventive.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signature

16/03/10

Date

Alfonso Izquierdo

Name in Print